

SPIDER FAUNA (ARANEAE: ARACHNIDA) OF RAJASTHAN WITH SPECIAL REFERENCE TO RANTHAMBORE NATIONAL PARK, RAJASTHAN, INDIA

Sumana Saha, D. C. Dhali* and D. Raychaudhuri*

Department of Zoology, Darjeeling Govt. College, Darjeeling, Govt. of West Bengal, India.
email: sahasumana2010@gmail.com

*Entomology Laboratory, Department of Zoology, University of Calcutta, 35, Ballygunge
Circular Road, Kolkata- 700019, India.

email: dhruba.83dhali@gmail.com, dinendrarccu@gmail.com

corresponding author: dinendrarccu@gmail.com

ABSTRACT

12 species of 10 genera belonging to 9 families were recorded from Ranthambore National Park, during 2008. *Thomisus italongus* Barrion and Litsinger and *Cyrtophora exanthematica* (Doleschall), are recognized as new from the country and accordingly described and illustrated.

Key words: Spiders, New records, Ranthambore National Park, Rajasthan, India.

INTRODUCTION

Protected areas are essential for biodiversity conservation. They act as benchmarks to understand human interaction with the natural world. Of the two mega diverse Indian states, Rajasthan with an area of about 342,239 sq. km. is the largest state of India. The state is symbolized by its arid and semi-arid tracts. Ecologically suitable forest areas of the state over time have been declared as National Parks, Wild Life Sanctuaries and Reserves. Wildlife wing of the State Forest Department (SFD) maintain these protected areas in a scientific manner, conducive for conservation of wild life in the area.

Temporal population of any life form actively select a suitable site for sustenance. Its fitness is directly influenced by the ability to find a suitable habitat based on innate preference for food, shelter and absence of enemies. Spiders are no exception to such a fact. They too are under strong selection pressure. Spiders, being a generalist predator are omnipresent almost in any ecosystem, maximum in forest system. Their diversity is largely governed by the availability of prey insects and structural complexity of the plant community (Chew, 1961; Riechert, 1970).

About 45,144 valid species belonging to 3,935 genera and 114 families are known globally (World Spider Catalog, 2015), while Indian fauna consists of 1686 valid species belonging to 438 genera and 60 families (Sebastian, 2009; Keswani *et al.*, 2012). Diversity of this particular group is rather poorly known from the state. Pocock (1903) was the first to report few species from Rajasthan. Studies of Subramanyam (1968, 69), and Roonwall (1982) revealed very little information on spiders. Tikader (1961) described a dozen species from the desert areas of the said state. Later he (1980, 1982) included some more species in his Fauna of India – Spiders. Sivaperuman and Rathore (2009) enlisted 28 species belonging to 21 genera and 13 families from the Desert National Park. Sen *et al.* (2009) reported 12 species belonging to 10 genera and 9 families from the Ranthambore National Park. Saini *et al.* (2012) identified 32 species during their expedition in Shekhawati Aravalian region.

Our first attempt to assess the spider diversity of Ranthambore National Park during 2008, has resulted in the recognition of 12 species under 10 genera belonging 9 families including the 2 newly recorded species, *Thomisus italongus* Barrion and Litsinger and *Cyrtophora exanthematica* (Doleschall) from the country. Other than mentioning necessary data for each of the recorded species, description and illustration of the above named species are provided.

Study area: Ranthambore National Park (among the 2 National Parks of the state) is a part of the much larger Ranthambore Tiger Reserve, a Project Tiger reserve, lies in the Sawai Madhopur district of eastern Rajasthan. It is right now the only forest reserve in Rajasthan and in the entire Aravali hill ranges where tigers exist. Today, this Project Tiger Reserve spans over 1334 sq. km of area, of which 400 sq. km is the Ranthambore National Park. The park falls within the Semi-arid zone and Gujrat, Rajwara Biotic Province 4B (Rodger and Panwar, 1988) limited between 26°01'02"N and 76°30'09"E.

MATERIALS AND METHODS

Spider samples collected during November, 2008 were preserved following Tikader (1987). Those were studied under Stereo Zoom Binocular Microscopes, model Olympus SZX-7 and Zeiss SV-11. The measurements indicated in the text are in millimeters (mm), made with an eye piece graticule. Materials are in the deposition of Entomology Laboratory, Department of Zoology, University of Calcutta, Kolkata.

Abbreviations used: AL= abdominal length, ALE= anterior lateral eye, AME= anterior median eye, AW= abdominal width, CL= cephalothoracic length, CW= cephalothoracic width, PLE= posterior lateral eye, PME= posterior median eye, TL= total length.

RESULTS

Key to families

1. Eyes grouped in a hexagon ----- Oxyopidae Thorell
- Eyes grouped in rows -----2
2. Eyes in 2 rows (4.4) ----- 3
- Eyes in 3 rows or 4 rows ----- 7
3. Legs laterigrade ----- 4
- Legs prograde----- 5
4. Apical end of metatarsi with a soft trilobite membrane; tarsi and metatarsi with scopulae; eyes usually not on tubercle ----- Sparassidae Bertkau
- Apical end of metatarsi without a soft trilobite membrane; tarsi and metatarsi without scopulae; lateral eyes usually on tubercles ----- Thomisidae Sundevall
5. 1st pair of legs noticeably longer than 4th pair, posterior spinnerets 2 segmented, distal one long, with cone shaped spinning area ----- Eutichuridae Lehtinen
- 1st pair of legs not noticeably longer than 4th pair; posterior spinnerets not segmented and distally without cone shaped spinning area ----- 6
6. Tarsi IV with ventral comb of serrated hairs; brownish ring around eyes-----
- Theridiidae Sundevall
- Tarsi IV without ventral comb of serrated hairs; such brownish ring absent -----

- Araneidae Clerck
7. Eyes arranged in 4.2.2 or 2.2.2.2 configuration, anterior row always forwardly directed with medians largest ----- Salticidae Blackwall
- Eyes arranged in 4.2.2 configuration, anterior row always upwardly directed, medians not largest----- 8
8. Carapace rectangular; posterolateral eyes more than four times their diameter apart ----- Eresidae C. L. Koch
- Carapace oval; posterolateral eyes less than four times their diameter apart ----- Lycosidae Sundevall

Family: Oxyopidae Thorell

(Lynx spiders)

Oxyopidae Thorell, 1870. Nov. Act. Reg. Soc. Sci. Upsaline, 7 (3): 196.

Genus: *Oxyopes* Latreille

Oxyopes Latreille, 1804. Nouv. Dict. d'Hist. Nat. Paris, 24: 135.

Key to species

1. Cephalic region with two longitudinal black lines on side; spermatheca bilobed, fertilization duct outwardly and upwardly curved

----- *shweta* Tikader

Cephalic region without longitudinal black line on either side; spermatheca comma shaped, fertilization duct outwardly and downwardly curved

----- *sitae* Tikader

Oxyopes shweta Tikader

Oxyopes shweta Tikader, 1970. Rec. Zool. Surv. India, 64: 78.

(Pl. I; Fig. 1)

Material examined: 3 female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha; 2 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha. Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Manipur, Meghalaya, Rajasthan, Sikkim, Tripura, West Bengal; China (Sethi and Tikader, 1988; Biswas and Biswas, 1992; Biswas and Biswas, 2004, 2006; Majumder, 2005, 2007; Gajbe, 2008; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).













Oxyopes sitae Tikader

Oxyopes sitae Tikader, 1970. Zool. Surv. India, 64: 75.

(Pl. I; Fig. 2)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha.

Distribution: India: Andaman, Gujarat, Meghalaya, Rajasthan, Sikkim, West Bengal; China (Sethi and Tikader, 1988; Biswas and Biswas, 1992; Biswas and Biswas, 2004; Majumder, 2007; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).

<p>Family - Oxyopidae</p>  <p>Fig. 1</p> <p><i>Oxyopes shweta</i> Tikader, 1970</p>	<p>Family - Oxyopidae</p>  <p>Fig. 2</p> <p><i>Oxyopes sitae</i> Tikader, 1970</p>	<p>Family - Sparassidae</p>  <p>Fig. 3</p> <p><i>Sparassus tener</i> Thorell, 1891</p>
<p>Family - Thomisidae</p>  <p>Fig. 4</p> <p><i>Thomisus andamanensis</i> Tikader, 1980</p>	<p>Family - Thomisidae</p>  <p>Fig. 5</p> <p><i>Thomisus italongus</i> Barrion & Litsinger, 1995</p>	<p>Family - Eutichuridae</p>  <p>Fig. 6</p> <p><i>Cheriacanthium melanostomum</i> (Thorell, 1895)</p>
<p>Family - Theridiidae</p>  <p>Fig. 7</p> <p><i>Argyrodes gazedes</i> Tikader, 1970</p>	<p>Family - Araenidae</p>  <p>Fig. 8</p> <p><i>Cyrtophora exanthematica</i> (Doleschall, 1859)</p>	<p>Family - Salticidae</p>  <p>Fig. 9</p> <p><i>Rhene albiger</i> C. L. Koch, 1846</p>
<p>Family - Salticidae</p>  <p>Fig. 10</p> <p><i>Telamonia dimidiata</i> (Simon, 1899)</p>	<p>Family - Eresidae</p>  <p>Fig. 11</p> <p><i>Stegodyphus sarasinorum</i> Karsch, 1891</p>	<p>Family - Lycosidae</p>  <p>Fig. 12</p> <p><i>Hippasa madhuae</i> Tikader & Malhotra, 1980</p>

Family: Sparassidae Bertkau

(Giant crab spiders)

Sparassidae Bertkau, 1872, Arch. Naturg., 38: 232.

Genus: *Olios* Walckenaer

Olios Walckenaer, 1837, Hist. nat. Ins. Apt., 1: 202.

Olios tener (Thorell)

Sparassus tener Thorell, 1891. Kongl. Svenska. Vet-Acad. Handl., 24(2): 80.

Olios tener (Thorell); Gravely, 1931. Rec. Indian Mus. Calcutta, 33:244.

(Pl. I; Fig. 3)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha.

Distribution: India: Bihar, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, West Bengal: Myanmar, Pakistan (Barrion and Litsinger, 1995; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).

Family: Thomisidae Sundevall

(Crab spiders)

Thomisidae Sundevall, 1833, Conspectus Arachnidum: 27.

Genus: *Thomisus* Walckenaer

Thomisus Walckenaer, 1805, Tableau des aranéides, Paris: 28.

Thomisus andamanensis Tikader

Thomisus andamanensis Tikader, 1980, Fauna of India (Araneae), 1: 39.

(Pl. I; Fig. 4)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Andaman, Rajasthan, West Bengal (Tikader, 1982; Sebastian and Peter, 2009; Keswani *et al.*, 2012; Saini *et al.*, 2012; World Spider Catalog, 2015).

Thomisus italongus Barrion and Litsinger

Thomisus italongus Barrion and Litsinger, 1995. CAB International, Wallingford, UK: 228-229.

(Pl. I; Fig. 5)

Description: Male: CL- 1.40, CW- 0.70, AL- 1.60, AW- 0.65, TL- 2.97. Cephalothorax yellowish brown medially and laterally dark brown, ocular area white in posterior eye row while anterior eye row dark brown, convex, anteriorly narrowed and rounded, medially widest, posteriorly rounded, roughened by minute tooth-like each clothed with a strong hair; highly raised at middle. Eyes 8, black, on tubercle, in 2 rows, both row moderately recurved, anterior shorter than posterior; ocular quad very much wider than long. Eye diameter- $ALE > AME > PLE = PME$. Inter ocular distance: $AME-AME- 0.20$, $ALE-AME- 0.24$, $ALE-ALE- 0.30$, $PME-PME- 0.30$, $PLE-PME- 0.28$, $PLE-PLE- 0.28$, $AME-PME- 0.30$, and $ALE-PLE- 0.34$. Clypeus brown, sloped, height high. Thoracic region sloped posteriorly. Chelicerae brown, subtriangular, short, robust, scopulate; fang brown, short, robust, erect. Labium brown, subtriangular, and scopulate. Maxillae light brown, longer than wide, outer

margin medially concave and scopulate. Sternum yellow-brown, cordate, anteriorly concave, posteriorly narrow and pointed between coxae IV, clothed with short hairs and pubescence. Legs brown, moderately short, 2 clawed, each superior with 1-3 pectinations, with claw tufts; femora I with 1-0-4-0, femora II with 1-0-0-0, and tibia I -II with - 0-1-0-0 spination. Leg measurements: I **3.37**(1.01, 0.44, 0.75, 0.62, 0.55); II **3.52**(1.03, 0.54, 0.79, 0.63, 0.53); III **2.29**(0.68, 0.38, 0.51, 0.38, 0.34); IV **2.16**(0.63, 0.33, 0.41, 0.42, 0.37). Leg formula- 2134.

Abdomen light brown, apically subtruncate and gradually narrowed to a strongly rounded posterior end, clothed with white, short hairs and strong spines; dorsum with 3 pale brown sigilla medially; venter pale brown and medially with 5 small sigilla.

Pedipalp: Retrolateral tibial apophysis triangular, projecting laterally, apex highly sclerotized and blunt; ventral tibial apophysis lightly sclerotized and bluntapically; intermediate tibial apophysis strongly developed with blunt apex. Embolous long, filiform, circling cymbium once. Tegular apophysis developed. Cymbium longer than wide.

Material examined: 1 Female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha.

Distribution: India (New record): Rajasthan; Philippines (Barrion and Litsinger, 1995; Majumder, 2007; World Spider Catalog, 2015).

Family: Eutichuridae Lehtinen

(Dark Sac Spiders)

Eutichuridae Lehtinen, 1967. Ann. Zool. Fenn. 4: 199-468.

Genus: *Cheiracanthium* C. L. Koch

Cheiracanthium C. L. Koch, 1839. Die Arachniden, Sechster Band. 9.

Cheiracanthium melanostomum (Thorell)

Eutittha melanostoma Thorell, 1895. Descriptive catalogue of the spiders of Burma.London, 44.

Cheiracanthium melanostomum (Thorell, 1895); Simon, 1901. Proc. zool. Soc.London, 1901(2): 67.

(Pl. I; Fig. 6)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha; 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Maharashtra, Rajasthan, West Bengal; Bangladesh, Myanmar (Tikader, 1981; Barrion and Litsinger, 1995; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).

Family: Theridiidae Sundevall

(Comb footed or cobweb spiders)

Theridiidae Sundevall, 1833, Conspectus Arachnidum: 15.

Genus: *Argyrodes* Simon

Argyrodes Simon, 1864, Histoire naturelle des araignées (aranéides), Paris: 253.

Argyrodes gazedes Tikader

Argyrodes gazedes Tikader, 1970, Rec. zool. Surv. India, 64: 11.

(Pl. I; Fig. 7)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Kerala, Rajasthan, Sikkim (Tikader, 1987; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).

Family: Araneidae Clerck

(True orb weavers)

Araneidae Clerck, 1757, Svenska spindlar, uti sina hufvud-slågter indelte samt under några och sextio särskildte arter beskrefne och med illuminerade figurer uplyste: 1.

Genus: *Cyrtophora* Simon

Cyrtophora Simon, 1864, Histoire naturelle des araignées (aranéides), Paris: 261.

Cyrtophora exanthematica (Doleschall)

Epeira exanthematica Doleschall, 1859, Acta Soc. Sci. Ind.-Neerl., 5: 38.

Cyrtophora exanthematica (Doleschall) Yaginuma, 1958, Acta Arachnol. Tokyo, 16: 14.

(Pl. I; Fig. 8)

Description: (Female)

CL - 2.71, CW - 2.21, AL - 6.43, AW - 4.39, TL - 9.14. Cephalothorax yellow brown, clothed with small brown hairs, anteriorly narrowing, cephalic region elevated, furrows deeply distinct, midlongitudinally with faintly marked furrow lined by faint black lines extending from posteromedian eyes to the end, thoracic region globose, depressed posteriorly, radii indistinct. Eyes 8, homogenous, transparent, basally ringed with black, arranged in 2 recurved rows with anterior row more so, ocular quad trapezoid, a little wider in front, eye diameter $AME \geq PME > PLE > ALE$. Interocular distance: $AME - AME = 0.36$, $ALE - AME = 0.36$, $ALE - ALE = 0.93$, $PME - PME = 0.29$, $PLE - PME = 0.43$, $PLE - PLE = 1.04$, $ALE - PLE = 0.21$, $AME - PME = 0.21$. Clypeus sloped, shorter than anteromedian eye diameter. Chelicerae yellow brown with boss, moderately long, each of pro and retromargin with 3 teeth; fang brown, long, sharp, stout and stumpy. Labium a little wider than long, basally brown, constricted, apically off white, narrowing to triangular, scopulate. Maxillae pale brown, slightly longer than wide, clothed with long brown setae, anterolaterally off white, margin scopulate. Sternum cordate, yellowish brown, margins at each coxal region tuberculate, tip projected between coxae IV, midlongitudinally with a broad white band narrowing distally, clothed with long, brown setae. Legs long, pale yellow, clothed with hairs, tarsi 3 clawed, superior claws 2, each with 5 pectination, inferior pectinate basally, accessory claws 4, pectinate throughout. Leg measurements: I **6.93** (2.14, 1.00, 1.79, 1.29, 0.71); II **6.28** (1.71, 1.00, 1.57, 1.29, 0.71); III **4.00** (1.43, 0.50, 0.79, 0.71, 0.57); IV **5.27** (1.57, 0.57, 1.21, 1.21, 0.71). Leg formula - 1243.

Abdomen creamy white, reticulate, isolaterally triangular, posteriorly produced, anteriorly strongly constricted and produced further into an obtuse triangle, that is much overhanging the cephalothorax. Dorsum medially decorated with grey, numerous small warts all over, marked by brown, shoulder humps obtuse with a pair of marginal tubercles, each marked by brown at tip, located at the broadest region; distally broadly bifurcate, tuberculate, its inner margin equally with small tubercles, 3 pairs of distinct brown sigillae (muscular apodeme) in longitudinal rows, margins striped with grey. Venter grey brown, medially white, longitudinally spotted with brown, clothed with long, erect, dark brown

hairs; spinnerets at the posteromedian regions, colulus distinct, triangular, book lungs yellow.

Epigynum: Internal genitalia: Epigynum with a short, triangular scape, spermatheca globular, fertilization duct short, upward, copulatory duct ventral, thick.

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha; 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India (New record): Rajasthan; Australia, Indonesia, Japan, Myanmar, Papua New Guinea, Philippines, Singapore (Majumder, 2007; Sivaperuman and Rathore, 2009; World Spider Catalog, 2015).

Family: Salticidae Blackwall

(Jumping Spiders)

Salticidae Blackwall, 1841, Trans. Linn. Soc., London, 18: 616.

Key to genera

1. Beetle like salticids; cephalothorax somewhat rounded, wider than long, clothed with thick 'mouse hairs' ----- *Rhene* Thorell

Never beetle like, cephalothorax somewhat longer than wide and clothed with simple hairs ----- *Telamonia* Thorell

Genus: *Rhene* Thorell

Rhene Thorell, 1869, Nova Acta reg. Soc. sci. Upsaliae, 7(3): 37.

Rhene albiger C. L. Koch

Rhene albiger C. L. Koch, 1846. Die Arachniden. Nürnberg, Dreizehnter Band, 34.

(Pl. I; Fig. 9)

Material examined: 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Rajasthan, West Bengal; Bintan Island, China, Indonesia, Japan, Krakatau, Malaysia, Nepal, South Korea, Vietnam (Proszynski, 2007; Sebastian and Peter, 2009; Dhali, 2010; Keswani *et al.*, 2012; Metzner, 2012; World Spider Catalog, 2015).

Genus: *Telamonia* Thorell

Telamonia Thorell, 1887, Ann. Mus. Civ. Stor. Nat. Genova, 25: 386.

Telamonia dimidiata (Simon)

Viciria dimidiata Simon, 1899, Ann. Soc. Ent. Belg., 43:118.

Telamonia dimidiata (Simon), Prószyński, 1984, Annls. Zool. Warsz, 37: 428.

(Pl. I; Fig. 10)

Material examined: 3 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha; 1 male, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Rajasthan, West Bengal; Bhutan, Indonesia, Singapore (Proszynski, 2007; Sebastian and Peter, 2009; Dhali, 2010; Keswani *et al.*, 2012; Metzner, 2012; World Spider Catalog, 2015).

Family: Eresidae C. L. Koch

(Social spiders)

Eresidae C. L. Koch, 1851. Nürnberg, Heft 5: 4.

Genus: *Stegodyphus* Simon 1867

Stegodyphus Simon 1867. Rev. Mag. zool., 19(2): 15.

Stegodyphus sarasinorum Karsch

Stegodyphus sarasinorum Karsch 1891. Berl. ent. Zeitschr. 36: 267.

(Pl. I; Fig. 11)

Material examined: 1 Female, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha; 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, West Bengal; Myanmar, Nepal, Sri Lanka, Nepal (Gajbe, 2004; Majumder, 2007; Sebastian and Peter, 2009; Keswani *et. al.*, 2012; World Spider Catalog, 2015).

Family: Lycosidae Sundevall

(Wolf spiders)

Lycosidae Sundevall, 1833. Conspectum Arachnidum, 1:39.

Genus: *Hippasa* Simon

Hippasa Simon, 1885. Bull. Soc. Zool. France, 10:31.

Hippasa madhuae Tikader and Malhotra

Hippasa madhuae Tikader and Malhotra, 1980. Fauna of India (Araneae), 1: 298-299.

(Pl. I; Fig.12)

Material examined: 2 Females, Ranthambore National Park, Rajasthan, India, 18. xi. 2008, coll. S. Saha; 1 female, Ranthambore National Park, Rajasthan, India, 19. xi. 2008, coll. S. Saha.

Distribution: India: Maharashtra, Rajasthan (Tikader, 1980; Sebastian and Peter, 2009; Keswani *et al.*, 2012; World Spider Catalog, 2015).

ACKNOWLEDGEMENTS

We thank Department of forest, Government of Rajasthan, D.P.I., Education Department, Government of West Bengal, Principal, Lady Brabourne College and 2nd year Zoology (Hons.) students (2008) of Lady Brabourne College and the Head, Department of Zoology, University of Calcutta for necessary support.

REFERENCES

- Barrion, A. T. and J. A. Litsinger. 1995. Riceland Spiders of South and South East Asia. CAB International, Wallingford, 700 p.
- Biswas, B. and K. Biswas. 2006. Araneae: Spiders. Fauna of Arunachal Pradesh, State Fauna Series. Zool. Surv. India, 13(2): 491-518.

- Biswas, B. K. and K. Biswas. 1992. State Fauna Series 3: Fauna of West Bengal, Araneae: Spiders, part 3: *Rec. Zool. Surv. India*, 357-500.
- Biswas, B. K. and K. Biswas. 2004. State Funa Series 10. Fauna of Manipur, Araneae: Spiders: *Rec. Zool. Surv. India*, 25-46.
- Chew, R. M. 1961. Ecology of spiders of a desert community. *J. New York Entomol. Soc.*, 9: 5 – 41.
- Dhali, D. C., S. Sen, S. Saha and D. Raychaudhuri. 2010. Jumping spiders (Araneae: Salticidae) of four reserve forests of Dooars, West Bengal. *Bionotes*, 12(1): 24-25.
- Gajbe, P. U. 2004. Spiders of Jabalpur, Madhya Pradesh (Arachnida: Araneae). *Rec. Zool. Surv. India, Occ. Paper*, 227: 154.
- Gajbe, U. A. 2008. Fauna of India and the adjacent countries: Spider (Arachnida: Araneae: Oxyopidae). *Rec. Zool. Surv. India*, 3: 1-117.
- Keswani, S., P. Hadole and A. Rajoria. 2012. Checklist of Spiders (Arachnida: Araneae) from India-2012. *Indian Journal of Arachnology*, 1 (1): 1- 129.
- Majumder, S. C. and B. K. Tikader. 1991. Studies on some spiders of the family Clubionidae from India. *Rec. Zool. Surv. India Occ. Pap.*, 102: 1-174.
- Majumder, S. C. 2005. Studies of some spiders from Eastern coastal region of India. *Mem. Zool. Surv. India*, 20(3): 1-57.
- Majumder, S. C. 2007. Pictorial handbook on spiders of Sunderbans, West Bengal. *Rec. Zool. Surv. India, Kolkata*: 137p.
- Metzner, H. 2012. Jumping spiders (Arachnida: Araneae: Salticidae) of the world, (< www.jumping-spiders.com >) accessed on {26.01.2015}.
- Pocock, R. I. 1903. Fauna of British India, Arachnida. *London*, 153–205.
- Proszynski, J. 2007. Monograph of the Salticidae (Araneae) of the World. Version Feb. 12, *Mus. Inst. Zool.*, PAN, (< <http://salticidae.org/salticid/main/htm>>) accessed on {26.01.2015}.
- Riechert, S. E. and W. G. Reeder. 1970. editors. Effects of fire on spider distribution on southwestern Wisconsin prairies: *Proceedings of the 2nd Midwest Prairie Conference*.
- Rodgers, W. A. and H. S. Panwar. 1988. Planning a Wildlife Protected Area Network in India. A report prepared for the Ministry of Environment and Forests and Wildlife, Government of India.
- Roonwall, M. L. 1982. Fauna of the Great Indian Desert (past and present composition). In: A. Singh (ed.) Desert resources and technology Jodhpur. *Scientific & Geo-Tech. Academy, Jodhpur*, Vol. 1, 186p.
- Saini, K. S., R. Chauhan and N. P. Singh. 2012. Analysis of spider density across Shekhawati Aravalian region of Rajasthan. *Indian Journal of Arachnology*, 1(2): 30-39.
- Sebastian, P. A. and K. V. Peter. 2009. Spiders of India. Univ. Press (India) Pvt. Ltd., 614 p.
- Sen, S., S. Saha and D. Raychaudhuri. 2009. Spiders of Ranthambore National Park, Rajasthan. *Insect Environ.*, 16 (4): 172-173.
- Sethi, V. D. and B. K. Tikader. 1988. Studies on some giant crab spiders of the family Heteropodidae from India. *Rec. Zool. Surv. India. Misc. Publ. Occas. Pap.*, 93: 1-94.
- Sivaperuman, C. and N. S. Rathore. 2009. Spiders in the Desert National Park. *Faunal Ecology and Conservation of the Great Indian Desert*, 49-52.

- Subramanyam, T. V. 1968. An introduction to the study of Indian spiders (part I). *J. Bombay Nat. Hist. Soc.*, 62(2): 453–462.
- Subramanyam, T. V. 1969. An introduction to the study of Indian spiders (part II). *J. Bombay Nat. Hist. Soc.*, 65(3): 462–726.
- Tikader, B. K. 1961. On a collection of spiders (Araneae) from the desert area of Rajasthan, *India. Rec. Indian Mus.*, 59: 435-443.
- Tikader, B. K. 1970. Spider fauna of Sikkim. *Rec. Zool. Surv. India*, 64: 83 p.
- Tikader, B. K. 1980. Fauna of India. Spiders. Vol. I. Araneae (Thomsidae and Lycosidae). *Rec. Zool. Surv. India*, Calcutta,: 446.
- Tikader, B. K. 1981. Studies on spiders of the genus *Castianeira* Keyserling (Family: Clubionidae) from India. *Bull. Zool. Surv. India*, 4: 257-265.
- Tikader, B. K. 1982. Fauna of India. Spiders. Vol. II. Araneae (Araneidae and Gnaphosidae). *Zool. Rec. Surv. India*, Calcutta,: 493.
- Tikader, B. K. 1987. Hand book of Indian spiders. ed. *Rec. Zool. Surv. India*, 251 p.
- World Spider Catalog, 2015. World Spider Catalog. Natural History Museum Bern, online at <http://wsc.nmbe.ch>, version (16), accessed on {26.01.2015}.